# Chemistry

## Lecture 7, 8 By: Syed Ali Shan

## S & P Block Elements

**Outline:**

- Electronic configuration
- Chemical properties of s-block elements
- Group 1 elements (Alkali metals)
- Atomic and physical properties
- Trends in reactivity
- Group 2 elements (Alkaline earth metals)
- Trends in reactivity
- Physical and chemical properties
- Group trends: atomic radii, ionic radii, Electronegativity, Ionization potential, electro-positivity or metallic character, electrical conductivity, melting and boiling points.
- Reactions of Group III elements with water, oxygen and chlorine

**Introduction to Periodic Table:**

- Proposed by Mosley [Based on atomic number]
- It has 7 periods represented with Arabic numerals
- Periods are horizontal rows
- $1^{st}$ period has 2 elements (shortest)
- $2^{nd}$ and $3^{rd}$ periods have 8 elements each (short/small periods)
- $4^{th}$ and $5^{th}$ periods have 18 elements each (long periods)
- $6^{th}$ periods has 32 elements (longest)
- $7^{th}$ period has 26 elements (incomplete)
- Vertical columns are called Groups represented with Roman numerals
- They are 8 and divided into subgroups A (8) and B (10)
- There are 4 Blocks (based on valence orbital)
- s-block and p-block have normal elements, d-block [$(n-1)d^{1-10}$, $ns^2$] has outer transition elements and f-block [$(n-1)d^1$, $(n-2)f^{1-14}$,$ns^2$] has inner transition elements
- s-block [$ns^{1-2}$] group IA and IIA elements, p-block [$ns^2$,$np^{1-6}$] group IIIA-VIIIA elements (except He)
- Electronic distribution in shells gives:(only for 2,3 periods)
    - Period no. = No. of shells
    - Group no. = electrons in last shell
    - Valency = No. of binding electrons in last shell
    - Nature → less than 4 electrons in valence shell means metal otherwise non-metal

**Example: $_7N$ = (2,5)** period = 2, Group = 5, Valency = 3, Nature = Non-metal

**Bridge Elements:** Li, Be, B, C, N, O

<table>
<tr><th>IA Group [Li, Na, K, Rb, Cs, Fr(radioactive)]</th><th>IIA Group [Be, Mg, Ca, Sr, Ba, Ra(radioactive)]</th></tr>
<tr><td>Exist in mineral forms</td><td>Exist in mineral forms</td></tr>
<tr><td>(valence E.C) $ns^1$</td><td>(valence E.C) $ns^2$</td></tr>
<tr><td>Oxidation state is +1</td><td>Oxidation state is +2</td></tr>
<tr><td>Monovalent</td><td>Divalent</td></tr>
<tr><td>More electropositive (high reactivity)</td><td>Less electropositive (high reactivity)</td></tr>
<tr><td>Reducing power increases down the group (except Li is strongest amongst all)</td><td>Reducing power increases down the group</td></tr>
<tr><td colspan="2">Elements of IA are stronger reducing agents than IIA elements</td></tr>
<tr><td>All IA elements form basic oxides<br><br>IA elements can form normal oxides, peroxides, superoxides.<br>Basicity increases down the group (as size of cation increases which results in increase of internuclear distance and ionization becomes easier)</td><td>IIA elements form basic oxides except Be (forms Amphoteric oxides) [Be can react with alkalies i.e. $Be + 2NaOH \rightarrow Na_2BeO_2 + H_2$]<br>IIA elements form normal oxide and peroxide only<br>Basicity increases down the group (as size of cation increases which results in increase of internuclear distance and ionization becomes easier)</td></tr>
<tr><td colspan="2">IA elements form more basic solutions/oxides than IIA elements</td></tr>
<tr><td>Reactivity increases down the group</td><td>Reactivity increases down the group</td></tr>
<tr><td colspan="2">IA Elements are more reactive than IIA elements</td></tr>
<tr><td>Atomic radius, Ionic radius, Metallic character, Electrical conductance, Ionic character increases down the group<br>Only Li can form covalent bond</td><td>Atomic radius, Ionic radius, Metallic character, Electrical conductance, Ionic character increases down the group<br>Be, Mg has can form covalent bonds</td></tr>
<tr><td colspan="2">Atomic radius, Ionic radius, Metallic character, Ionic character of IA is higher than IIA elements</td></tr>
<tr><td>Density increases down the group with exception of potassium.<br>Cs > Rb > Na > K > Li</td><td>Density first decrease upto Calcium then increases till the end of the group<br>Ba > Sr > Be > Mg > Ca</td></tr>
<tr><td colspan="2">Density of IA elements is less than IIA elements</td></tr>
<tr><td>Hardness decreases down the group<br>Softer than IIA</td><td>Hardness decreases down the group<br>Harder than IA</td></tr>
<tr><td>I.E, E.A, E.N and heat of hydration values decreases down the group due the increase in size</td><td>I.E, E.A, E.N and heat of hydration values decreases down the group due the increase in size</td></tr>
<tr><td colspan="2">I.E, E.A, E.N and heat of hydration values of IA elements are less than their corresponding IIA elements</td></tr>
<tr><td>M.P and B.P decreases down the group due to increases in size</td><td>M.P and B.P decreases down the group due to increases in size with few exceptions<br>M.P Be > Ca > Sr > Ba > Mg<br>B.P Be > Ba > Ca > Sr > Mg</td></tr>
<tr><td colspan="2">M.P and B.P of IA elements are lower than IIA elements</td></tr>
<tr><td>Polarizing power decreases down the group</td><td>Polarizing power decreases down the group</td></tr>
<tr><td colspan="2">IIA elements have more polarizing power than IA elements</td></tr>
<tr><td colspan="2">Flame Colours</td></tr>
<tr><td>Li (Red/Crimson red) Na (Golden yellow)<br>K [Lilac(violet) /pink]<br>Rb (Red /Reddish-violet) Cs (Blue)</td><td>Mg (white) Ca (Brick red/Orange-red)<br>Sr (Crimson red/Red)<br>Ba (Pale green/apple green)</td></tr>
</table>

# Reactions of Group IA Elements

**Reaction with Water:**

- All IA elements react with water forming hydroxide along with evolution of $H_2$ gas

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

- Very rapid and exothermic reactions
- Reaction becomes increasingly vigorous from Li to Cs.
- K, Rb and Cs react with ice even at $-100^0C$

**Reaction with $O_2$/Air:**

- React with $O_2$ or air rapidly and the surface of metal is tarnished due to formation oxide layer
- Stored in kerosene or paraffin oil
- **Li** forms lithium monoxide (normal oxide), a white solid

$$2Li + O_2 \rightarrow 2Li_2O$$

- The oxide formed reacts with $CO_2$ in the air to form carbonate

$$Li_2O + CO_2 \rightarrow Li_2CO_3$$

- **Na** forms normal oxide in limited supply of oxygen
- In presence of excess oxygen Na forms pale yellow peroxide

$$2Na + O_2 \rightarrow Na_2O_2$$

- **K, Rb, Cs** form superoxides (orange yellow)

$$K + O_2 \rightarrow KO_2$$

- **Cs** explodes spontaneously when in contact with air or oxygen
- Normal oxides of alkali metals other than Li are not prepared directly, so they are prepared by indirect methods i.e. by reducing peroxides, nitrates and nitrites with metal itself

$$2Na_2O_2 + 4Na \rightarrow 4Na_2O$$

$$2NaNO_2 + 6Na \rightarrow 4Na_2O + N_2$$

$$2NaNO_3 + 10Na \rightarrow 6Na_2O + N_2$$

- **Normal oxides** ($O^{2-}$) [anti-fluorite structure] react with water to form hydroxide ions by proton exchange

$$[O^{2-} + H_2O \rightarrow OH^- + OH^-]$$

$$Li_2O + H_2O \rightarrow 2LiOH$$

- **Normal oxides** ($O^{2-}$) react with HCl to form salt and water

$$Li_2O + 2HCl \rightarrow 2LiCl + H_2O$$

  - ✓ **Peroxides** [$O_2^{2-}$ $(\text{-O-O})^{2-}$] strong oxidizing agent, react with water in cold conditions (as highly exothermic reaction and increase in T decomposes $H_2O_2$ into water and oxygen) to give hydroxide and $H_2O_2$

$$Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$$

  - ✓ **Peroxides** [$O_2^{2-}$ $(\text{-O-O})^{2-}$] react with HCl (is even more exothermic than with water) to form salt and $H_2O_2$ which further decomposes to water and oxygen if temp. rises again

$$Na_2O_2 + 2HCl \rightarrow 2NaCl + H_2O_2$$

- **Superoxides** $O_2^{\cdot -}$ $:\ddot{O}:\ddot{O}:$ strong oxidizing agent [paramagnetic and coloured due to unpaired electron], react with water (highly exothermic reaction and increase in T decomposes $H_2O_2$ into water and oxygen) to give hydroxide and $H_2O_2 + O_2$

$$2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$$

- **Superoxides** react with HCl (is even more exothermic than with water) to form salt and $H_2O_2$ + $O_2$ [$H_2O_2$ further decomposes to water and oxygen if temp. rises again]

$$2MO_2 + 2HCl \rightarrow 2MCl + H_2O_2 + O_2$$

**Reaction with Chlorine:**

- All alkali metals react with chlorine to give chlorides [white solids] (neutral salts)
- **Li and Na** react slowly at room temp. but **molten Na** burns with brilliant yellow flame in chlorine atmosphere to form NaCl [$2Na + Cl_2 \rightarrow 2NaCl$]
- **K, Rb and Cs** react vigorously with halogens to form halides

- They all *react with hydrogen* to form hydrides (MH which are reducing agents),
- They all *react with Sulphur* to form sulphides ($M_2S$)
- Only Li amongst IA elements reacts with Nitrogen (to form nitride) and Carbon (to form carbide)

## Reactions of Group IIA Elements

**Reaction with Water:**

- **Beryllium** does not react even at red hot temperature
- **Magnesium** reacts slowly with boiling water and quite rapidly with steam

$$Mg + H_2O \xrightarrow{100^0C} MgO + H_2$$

- Very clean Mg ribbon has very slight reaction with cold water. After several minutes bubbles of $H_2$ gas evolve. However the reaction soon stops because magnesium hydroxide formed almost insoluble in water and forms a barrier for Mg preventing further reaction
- **Calcium, strontium and barium** produce hydroxide with water (exothermic reactions)

$$M + 2H_2O \rightarrow M(OH)_2 + H_2$$

**Reaction with Air/Oxygen:**

- IIA elements when burnt in oxygen form **normal oxides except Barium** (forms peroxide)
- **Sr can also form peroxide** if burnt in oxygen **under high pressure**
- **Beryllium (Be)** is resistant to complete oxidation due to stable layer of BeO
- It oxidizes rapidly at about $800^0$C

$$2Be + O_2 \xrightarrow{800^0C} 2BeO$$

- Not tarnished by atmosphere but soon **loses silvery appearance**
- **Magnesium (Mg)** quickly becomes coated with MgO layer which protects it from further corrosion at ordinary temperature

$$2Mg + O_2 \rightarrow 2MgO$$

- Mg burnt in air produces small amount of nitride ($Mg_3N_2$) along with MgO
- **Barium (Ba)** forms peroxide

$$Ba + O_2 \xrightarrow{500-600^0C} BaO_2$$

**Reaction with Nitrogen:**

- IIA elements react with nitrogen to give nitrides
- Nitrides hydrolyze vigorously with water giving ammonia and respective hydroxide

$$3Mg + N_2 \rightarrow Mg_3N_2$$

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$

- IIA elements in molten form react with hydrogen under high pressure to give hydrides

$$Mg + H_2 \xrightarrow[MgI_2]{pressure} MgH_2$$

- IIA elements react with sulphur to give metal sulphides (MS) which on hydrolysis liberate $H_2S$
- IIA elements react with halogens to give metal halides ($MX_2$)

## Thermal Decomposition and Solubility of compounds of IA

**Oxides:**

- All are soluble in water giving respective hydroxides
- It is an **acid base reaction** which involves decomposition of water by oxide ion
- **$KO_2$** absorbs $CO_2$ while giving off $O_2$ gas at same time, therefore used in breathing equipment

**Hydroxides:**

- All are crystalline solids
- Generally hygroscopic
- All are soluble in water except LiOH
- All are stable to heat except LiOH which decomposes to $Li_2O + H_2O$

**Carbonates:**

- All are soluble in water except $Li_2CO_3$
- All are stable to heat except $Li_2CO_3$ [gain of electrostatic attraction in converting from carbonate to oxide is considerable in case of $Li^+$ ion not for other large sized ions]
- They decompose to give respective oxides $Li_2CO_3 \rightarrow Li_2O + CO_2$
- **Sodium carbonate:** Below 35.2$^0$C it crystallizes out as $Na_2CO_3.10H_2O$ called washing soda [on standing in air it slowly loses water and convert to white powder $Na_2CO_3.H_2O$] and above 35.2$^0$C it crystallizes out as $Na_2CO_3.H_2O$

**Sulphates/Nitrates:**

- All sulphates and nitrates are soluble in water
- Lithium nitrate discomposes differently from rest

$$4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$$

$$2NaNO_3 \rightarrow 2NaNO_2 + O_2$$

## Thermal Decomposition and Solubility of compounds of IIA

**Oxides:**

- Lattice energy decreases down the group
- Solubility increases down the group
- **BeO and MgO are insoluble** while others are soluble and react with water to give hydroxides
- **BeO** is Amphoteric oxide while rest are basic
- Due to small size of $Be^{+2}$ ion, BeO is covalent while others are ionic
- It is harder than others with high M.P than other oxides
- Each Be is tetrahedrally coordinates with 4 O-atoms

**Amphoteric oxides** [Be (IIA), Zn (IIB),[Al,Ga, In] (IIIA), [Ge, Sn, Pb] (IVA), [As, Sb, Bi] (VA)]

**Hydroxides:**

- Lattice energy decreases down the group
- Solubility increases down the group
- **$Be(OH)_2$ insoluble, $Mg(OH)_2$ sparingly soluble** while others are soluble
- They decompose to give respective oxides $Mg(OH)_2 \rightarrow MgO + H_2O$
- Ease of decomposition increases down the group
- $Be(OH)_2$ is Amphoteric while others are basic hydroxides
- It is covalent (due to small size of $Be^{+2}$ ion) while others are ionic
- Saturated solution of $Ca(OH)_2$ in water is **Lime water** used as test for $CO_2$
- Suspension of Mg(OH)2 in water is **Milk of magnesia** used for treatment of acidity of stomach
- Suspension of Ca(OH)2 in water is **Milk of lime** used as white wash

**Carbonates:**

- Lattice energy increases down the group
- Slightly soluble in water
- Solubility decreases down the group
- They decompose to give respective oxides $CaCO_3 \rightarrow CaO + CO_2$
- Ease of decomposition decreases down the group

**Sulphates:**

- Lattice energy increases down the group
- Solubility decreases down the group
- **$BeSO_4$, $MgSO_4$ are fairly soluble**, **$CaSO_4$ is slightly soluble**
- **SrSO4 and BaSO4 are almost insoluble**
- Ease of decomposition decreases down the group
- Gypsum on heating above $100^0C$ loses 3 quarters of water of crystallization to give Plaster of Paris

$$2CaSO_4.2H_20 \text{ (gypsum)} \rightarrow (CaSO_4)_2.H_2O \text{ (Plaster of Paris)} + 3H_2O$$

**Nitrates:**

- Soluble in water
- On decomposition produce $O_2$, $NO_2$ and metal oxide

$$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$$

# Reactions of Group IIIA Elements

**Reaction with Water:**

- Neither B nor Al react with water at room temp. but both react with steam to liberate $H_2$ gas
- Aluminium reacts in powder form

$$2B + 6H_2O \rightarrow 2H_3BO_3 + 3H_2$$

$$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$$

- Inertness of Al is due to protective oxide layer [reaction is very slow due to layer that build up even during reaction]
- In the absence of oxygen, gallium and indium are unaffected by water.
- Thallium the most metallic elements of IIIA reacts slowly with hot water and readily with steam to produce thallium oxide ($Ti_2O$)
- Thallium forms poisonous thallium hydroxide [TiOH] in moist air in presence of oxygen

**Reaction with Oxygen:**

- Only thallium is affected by air at room temp. and thallium (III) oxide is slowly formed
- All the elements however burn in air when strongly heated and with exception of gallium form the oxide $M_2O_3$; gallium forms a mixed oxide of composition GaO
  - $4B + 3O_2 \rightarrow 2B_2O_3$ $\quad$ $2B + N_2 \rightarrow 2BN$
  - $4Al + 3O_2 \rightarrow 2Al_2O_3$ $\quad$ $2Al + N_2 \rightarrow 2AlN$
- Reactivity increases down the group; boron is unreactive in crystalline form but reacts in finely divided form
- Aluminium powder is heated at $800^0$C and above, the metal will react with air to form $Al_2O_3$, AlN. The reaction is accompanied by evolution of heat and intense white light (used in flash light photography and thermite process)
- Because of ability to combine with oxygen, nitrogen aluminium is used to remove air bubbles from molten metals

**Reaction with Chlorine:**

- React with halogens at high temperature to form tri-halides ($MX_3$)

$$2M + 3X_2 \rightarrow 2MX_3$$

- Boron forms covalent liquid boron trichloride on heating in chlorine gas

$$2B + 3Cl_2 \rightarrow 2BCl_3$$

- Aluminium burns with stream of chlorine when passed over heated aluminum foil to produce very pale yellow aluminum chloride (polymeric halide) [$BeCl_2$, $AlCl_3$, $GaCl_3$ are polymeric halides]

$$2Al + 3Cl_2 \rightarrow 2AlCl_3$$

## Atomic Radius

- Average distance between nucleus and valence electrons, can be measured as covalent radius
- Covalent radius = half of bond length of homo-atomic molecule

**Periodic Trend:**

**Down the Group:**

- Down the group no. of shells, shielding effect increases and effective nuclear charge decreases
- Hold of nucleus on valence electrons decreases and size increases

**Along the Period:**

- Along the period no. of shells, shielding effect remains same and nuclear charge increases
- Hold of nucleus on valence electrons increases and size decreases

- Maximum radius is of IA and minimum is of VIIIA [same period]

## Ionic Radius

- Size of an ion while considering it to be spherical in shape

**Periodic Trend:** Same as of Atomic Radius

- **Cation:**
  - Formed by loss of electrons
  - Size of cation < size of parent atom i.e. Na= 186 pm, $Na^{+1}$ = 102 pm (Check it from latest addition of text book)
  - Larger the positive charge, smaller is the radius (no. of shells should be same)
  - $Li^{+1} > Be^{+2} > B^{+3}$ (iso-electronic)
- **Anion:**
  - Formed by gain of electrons
  - Size of anion > size of parent atom i.e. F= 72 pm, $F^{-1}$ = 133 pm (Check it from latest addition of text book)
  - Larger the negative charge, larger is the radius (no. of shells should be same)
  - $N^{-3} > O^{-2} > F^{-1}$ (iso-electronic)

$$r_{-} > r_{vander\ waal} > r_{covalent} > r_{+}$$

## Melting and Boiling Points

**Along the Period:**

- Increases from IA to IVA and then decreases from VA to VIIIA
- It is because;

- No. of binding electrons increases up to IVA and then decreases from VA to VIIIA (Bonding changes)
- IA-IVA elements usually exist as giant/large molecules
- While VA-VIIIA elements are simple molecules with weak intermolecular forces

**Down the Group:**

- Usually decreases down the group but in case of VIIA and VIIIA, it increase down the group
- It is because;
    - Down the group polarizability increases due to size increase
    - As a result London forces increases

**Exceptional Cases:**

- Group IIA has; **Be > Ca > Sr > Ba > Mg**(due to loose hexagonal packing in Mg)
- **S > P** because sulphur exists as $\mathbf{S_8}$ and phosphorous as $\mathbf{P_4}$

## Ionization Energy (I.E)

**Def:** Minimum amount of energy required to remove valence electron of an isolated gaseous atom

- Measured in $Kjmol^{-1}$
- Property of an element in free state

**Factors:**

- Atomic size inversely related to I.E
- Shielding effect inversely related to I.E
- Nuclear charge directly related to I.E
- Nature of orbital
    - **s > p > d > f** (I.E/Penetration order)
    - Because s orbital is of small size with more penetrating power than all others
- Stable the electronic configuration directly related to I.E
- $3^{rd}$ I.E > $2^{nd}$ I.E > $1^{st}$ I.E

**Periodic Trend:**

- Decreases down the group due to increase in size (size explained in atomic radius)
- Increases along the period due to decrease in size (size explained in atomic radius)

**Exceptional Cases:**

- Only along period i.e.
- **IIA > IIIA and VA > VIA**
- It is due to stable electronic configuration

- Stability order for orbitals: **Completely filled > half filled > partially filled**

- **IA < IIIA < IIA < IVA < VIA < VA < VIIA < VIIIA** (Along the period)
- **$ns^1 < np^1 < ns^2 < np^2 < np^4 < np^3 < np^5 < np^6$**
- Ionization energy will increase with increases in positive charge (when iso-electronic)
- $Al^{+2}$, $Mg^{+1}$, $Na^{+1}$, $Ne^{+1}$ which has maximum I.E?

**Applications:**

- Metallic character
  - Low I.E means metal, High I.E means non-metal
  - Valency (difference b/w I.E's values)

## Electron Affinity (E.A) [Just read not directly in outline]

**Def:** Energy change when an electron is added to valence shell of an isolated gaseous atom

- Measured in $Kjmol^{-1}$
- Property of an element in free state
- Usually 1st E.A is negative with few exceptions $O + 1e^- \rightarrow O^-$ E.A = -141 $kjmol^{-1}$
- 2nd E.A is positive as energy is req. to add 2nd electron to overcome the repulsion for incoming electron $O^- + 1e^- \rightarrow O^{-2}$ E.A = +744 $kjmol^{-1}$

**Factors:**

- Atomic size inversely related to E.A
- Shielding effect inversely related to E.A
- Nuclear charge directly related to E.A
- Nature of orbital
- Stable the electronic configuration inversely related to E.A
  - IIA, IA → positive values of E.A
  - Nitrogen (VA) → very small values nearing zero
  - Noble gases → Nearly zero/positive values
  - Halogens → Highest values in table

**Periodic Trend:**

- Decreases down the group due to increase in size (size explained in atomic radius)
- Increases along the period up to VIIA due to decrease in size (size explained in atomic radius)

**Exceptional Cases:**

- **Period IIIA elements have more E.A values than their respective period IIA elements like Cl > F, S > O, P > N etc.**
- **Halogens → Cl > Br > F > I**
- **IIA elements have low E.A than IA elements and VA elements less than IVA elements**

## Electronegativity (E.N)

**Def:** Ability of an atom to attract shared pair of electrons towards itself

- No unit
- Property of an element in combined state
- It is a relative term
- Related to I.E and E.A
- Same atoms i.e. H-H → zero E.N difference
- Different atoms i.e. H-F → E.N difference exists

**Factors and effect same as for I.E and E.A**

**Periodic Trend same as for I.E and E.A**

**Applications:**

- E.N difference gives;
  - Bond energy
  - Dipole moment
  - Ionic/Covalent character
    - If E.N difference equal or less than 0.4 (Non-polar covalent)
    - If E.N difference > 0.4 but < 1.7 (Polar covalent)
    - If E.N difference > 1.7 (Ionic)
    - If E.N difference = 1.7 (50 % each ionic and covalent)

## Electrical Conductance

**Def:** Tendency to conduct electricity due to free electrons in the structure

- It depends upon;
  - Presence of loose electrons in valence shell
  - Easy removal of loose electrons to form electronic cloud within structure

**Periodic Trend:**

- IA, IIA, IIIA (except B) show excellent conductivity which increases down the group
- However, this trend is not free from individual variations
- Metals of group IB (coinage metals i.e. Ag > Cu > Au) are extraordinary values of electrical conductance
- Non-metals of VIA and VIIA show low values electrical conductance that they are considered bad conductors or insulators
- Transition elements show very abrupt change in electrical conductivity
- Carbon in form of Diamond is insulator (All 4 valence electrons are tetrahedral bonded)

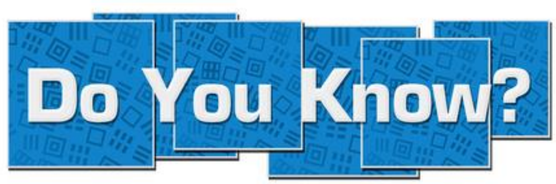
- Carbon in form of Graphite is conductor (one of 4 electrons is not bounded i.e. free electrons in layers)
- Lower members of IVA (Sn, Pb), VA (Bi) are metals with good electrical conductivity values comparable with IA

**Special Case:**

In period 3, the electrical conductance increases from **Na to Mg till Al has maximum** and then suddenly decreases onwards

## Electro positivity or Metallic character

- Tendency of element to lose electron is called metallic character
- Elements of periodic table are divided into metals, non metals and metalloids
- **Metals:** Good conductors of heat and electricity
  Tendency to lose electron to form cation
  Form basic oxides which gives bases when dissolved in water
- ✓ **Down the Group:** Increases as removal of electron becomes easier due to increase in size
- ✓ **Across the Period:** Decreases as removal of electron becomes difficult due to decrease in size
- **Non-Metals:** Poor conductors of heat and electricity
  Tendency to gain electron to form anion
  Form acidic oxides which gives acids when dissolved in water
  All gases are non metals
- ✓ **Down the Group:** Decreases due to increase in size [F > Cl > Br > I]
- ✓ **Across the Period:** Increases due to decrease in size




**$CO$, $NO$, $N_2O$, $H_2O$ are neutral oxides**